WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005KY48B

Title: Reconstructing Late Quaternary Paleohydrology of the Lower Ohio Valley

Project Type: Research

Focus Categories: Sediments, Hydrogeochemistry, Climatological Processes

Keywords: stable isotopes, geomorpholical processes, lake, speleothem

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Non-Federal Matching Funds: $58,634

Congressional District: KY 6th

Principal Investigator:
Harry Rowe

Abstract

Kentucky possesses two very important Late Quaternary paleohydrological archives: lacustrine sediments and speleothems (cave deposits). Extensive glacial-age lacustrine and alluvial deposits along the northern border of the state reveal that 1) Kentucky is geographically located in a unique region that yields important paleoclimatic information regarding atmospheric circulation patterns and geomorphic responses to climate change in an area proximal to past continent-scale ice sheets, and 2) Quaternary climate change and its impacts on the drainage patterns within the Ohio Valley have a commanding effect on the modern surface and near-surface hydrology of Kentucky. Preliminary investigations undertaken by the USGS and KGS along the Ohio River in the vicinities of Owensboro and Paducah identified at least two large Wisconsin-age paleolakes within the glacial valley train. In addition, investigations in the Salt River basin revealed that the lower reaches of the Salt and its tributaries were occupied by a large, long-lived paleolake, perhaps during Illinoisan and Wisconsin glacial episodes. The proposed study expands on previous paleolimnological work by 1) constructing coherent geochronologies for Wisconsin-age fluvio-lacustrine deposits in the lower Ohio Valley drainage, 2) characterizing regional variability in geomorphic/hydrological settings during the last glacial episode, and 3) developing a paleohydrology/paleoclimatology record from lacustrine facies preserved in the Salt River basin. While speleothem-based

records of paleohydrological change have been developed in many karstified regions of the globe over the past decade, no such records exist from Kentucky's world-renown karst systems. Preliminary results developed for the proposed study suggest that 1) abundant speleothems from several locations across the Interior Low Plateau of Kentucky can be age-dated by the U-series disequilibrium method and possess a wide range of ages, and 2) geochemical results from Kentucky speleothems record distinct and sizeable shifts in what is presumably regional hydrology. The proposed study seeks to 1) develop and expand the speleothem-based records of paleohydrological change in the region, and 2) better define the hydrogeological significance of isotopic and geochemical signatures archived in speleothems. The proposed research relies largely upon the AMS-14C and the U-series disequilibrium methods for proper age control for lake sediments and speleothems, respectively. In addition, isotopic and geochemical tracers of paleowaters preserved in sedimentary components (ostracode carapaces, organic matter) and in the calcite lattice of speleothems are to be used to infer hydrological transformations brought about by large-scale climatic and regional-scale geomorphic changes. Improved geochronological and geochemical constraints on glacial-age sedimentary deposits within the lower Ohio Valley drainage network will yield a clearer understanding of 1) the effect glacial processes had on regional paleohydrology, and 2) the effect glacial processes have on the modern hydrologic system. Geochemical and geochronological studies of speleothems across the Upper Cumberland, the Middle/Lower Kentucky, and the Green River basins will provide a continuous record of paleohydrological changes that extends into the past at least to the last interglacial (~130,000 years BP). Both paleolimnological and speleological components of the study will provide a more comprehensive evaluation of the spatial limits associated with utilizing surface and near-surface water resources in the region.